

AMENDMENTS TO THE SPECIFICATION

Please add the following sub-heading and paragraph to the specification after the title of the application:

CROSS-REFERENCE TO RELATED APPLICATION

This application is a National Stage of International Application No. PCT/SG02/00244, filed October 19, 2002, and which is hereby incorporated by reference.

Please replace the 4th paragraph starting on page 2 of the filed application with the following amended paragraph:

Up to this point, the intention of the present invention is evident, that is to provide a generic recipe for making of moulded shape bodies and paper liner from low consistency slurry containing treated agricultural fibres, ~~hereinafter known as AgroFibre~~, **(e.g., AGROFIBRE)** as the major component.

Please replace the 1st paragraph starting on page 4 of the filed application with the following amended paragraph:

The present invention discloses a formulation of using a low consistency **AgroFibre agricultural fibre** slurry for manufacturing ~~environmental~~ **environmentally** friendly and biodegradable moulded products and paper liners.

Please replace the 2nd paragraph starting on page 4 of the filed application with the following amended paragraph:

The ~~AgroFibre~~ **agricultural fibre** slurry ~~consists of~~ **includes a natural** adhesive **formulation** ~~hereinafter known as AgroBinder~~, **(e.g., AGROBINDER)** and hydrothermally processed agricultural fibres, ~~AgroFibre~~.

Please replace the 3rd paragraph starting on page 4 of the filed application with the following amended paragraph:

An object of the present invention is that the adhesive, ~~AgroBinder~~, is a starch-based, alkaline and viscosity stable adhesive that is a natural polymer and is biodegradable on its own.

Please replace the 4th paragraph starting on page 4 of the filed application with the following amended paragraph:

Another object of the present invention is to eliminate the use of chemical treatment of agricultural plant fibres so that polluting effluent can be totally avoided while increased affiliation with adhesive, ~~AgroBinder~~, is achieved. In the present invention, agricultural fibres including empty fruit bunches (EFB) of oil palm, coconut coir, bagasse and rice husk ~~are~~ may be processed through mechanical means under hydrothermal conditions using live steam to produce **AgroFibre processed agricultural fibres (e.g., AGROFIBRE)**. Technical ~~specification specifications~~ of ~~AgroFibre affects~~ the processed agricultural fibres may affect the performance of ~~AgroBinder the adhesive~~ and functional chemicals such as sizing, wet strength and grease barrier.

Please replace the 5th paragraph starting on page 4 of the filed application with the following amended paragraph:

According to another object of the present invention, ~~AgroBinder the adhesive~~ is self-retaining to ~~AgroFibre the processed agricultrual fibres~~ and its formulation allows functional chemicals to impart sizing, grease barrier and wet strengthening properties to the finished **AgroFibre agricultural fibre** products, be it moulded packaging or paper liner.

Please replace the 6th paragraph starting on page 4 of the filed application with the following amended paragraph:

According to another object of the present invention, ~~AgroFibre is the~~ **processed agricultural fibres may be** obtained by a chemical-free treatment in which agricultural fibres are processed in a hydrothermal digestion tank using superheated steam at an operating temperature between 150-250 deg C. and pressure between 0.3 MPa to 3 MPa for a residence time of 10 to 120 ~~min~~ **minutes**.

Please replace the 7th paragraph starting on page 4 of the filed application with the following amended paragraph:

According to yet another object of the present invention, the moulded shape bodies and paper liners are manufactured using ~~AgroFibre~~ **the agricultural fibre** slurry as the moulding material. The ~~AgroFibre~~ **agricultural fibre** slurry ~~consists of~~ **includes** thoroughly reacted ~~AgroFibre~~ **processed agricultural fibres**, water, ~~AgroBinder~~ **adhesive** and optional functional additives. During the moulding process, the ~~AgroFibre~~ **agricultural fibre** slurry is mechanically dewatered and thermally cured to give the required shape and mechanical properties. The weight percentage of ~~AgroFibre~~ **agricultural fibres** in the final product is in the range of 90 to 97% with ~~AgroBinder~~ **adhesive** and functional additives taking up the rest of the composition. Another aspect of the formulation of ~~AgroFibre~~ **the processed agricultural fibres** allows the manufacturing of moulded ~~AgroFibre~~ **agricultural fibre** shaped bodies from low consistency ~~AgroFibre~~ **agricultural fibre** slurry using the modified moulded pulp manufacturing process.

Please replace the last paragraph starting on page 4 and spanning to page 5 of the filed application with the following amended paragraph:

~~AgroBinder is made of~~ The adhesive formulation may include the following compositions: water, starch carrier, ungelatinized starch, modified starch, green-bond developing agent and caustic. ~~AgroBinder is~~ The adhesive formulation may be manufactured based on the following process: starch carrier phase at pH between 12-14 is cooked to give gelatinized starch, to which ungelatinized starch is added under continuous heating and stirring conditions. Next, green-bond developing agents are added to the above mixture. Mixing is continued for at least 30 minutes until a homogenous gelatinized mixture is obtained.

Please replace the 1st paragraph starting on page 5 of the filed application with the following amended paragraph:

According to yet another aspect of the invention, the formulation of **AgroBinder adhesive** also makes paper-making possible from **AgroFibre agricultural fibres** without going through intensive chemical pulping ~~process~~ processes, hence establishing a pollution-free paper-making approach.

Please replace the 2nd paragraph starting on page 5 of the filed application with the following amended paragraph:

FIG. 1 illustrates the chemical-free, multi-stage treatment process of agricultural **fibre fibres** under hydrothermal condition via mechanical means to produce a required quality of **AgroFibre agricultural fibres**.

Please replace the 3rd paragraph starting on page 5 of the filed application with the following amended paragraph:

FIG. 2 shows the preparation of a low consistency **AgroFibre agricultural fibre** slurry ready for the manufacturing of moulded shaped bodies and paper liners.

Please replace the last paragraph starting on page 5 and spanning to page 6 of the filed application with the following amended paragraph:

EFB fibres [20] are fed into a screw press [21] for further removal of its oil content. The screw press [21] applies pressure to the EFB fibres [20] to squeeze the residual oil [25] and water from the EFB fibres [20]. The residual oil [25] is an additional income for the palm oil mill. The de-oiled and dewatered EFB fibres are then fed into a hydrothermal digestion tank [22]. The hydrothermal digestion tank [22] is supplied with superheated live steam. The operation condition of the digestion tank [22] is kept at a temperature between 150 deg C. to 250 deg C., with a pressure of 0.3 MPa to 3 MPa. The EFB fibres in the hydrothermal digestion tank [22] are continuously agitated for 10 to 120 ~~mins~~ minutes and preferably 30 to 60 ~~mins~~ minutes under the set pressure and temperature. The agitation action increases the salvation effect of the superheated steam and facilitates delignification of EFB fibres. The hydrothermally treated EFB fibres are discharged from the digestion tank [22] and then cut by a cutter [23] to the desired length between 1 to 50 mm and preferably 10 to 30 mm. Next, the cut EFB fibres are fed into a disc refiner [24] to produce ~~the AgroFibre processed~~ agricultural fibres (e.g., AGROFIBRE) [30]. The refiner [24] is similar to those found in the pulp industry such as a disc refiner. The ~~AgroFibre processed~~ agricultural fibres [30] at the output of the refiner [24] ~~has~~ have high moisture content. ~~It~~ The processed agricultural fibres [30] can be used immediately in an in-line process or if storage of ~~AgroFibre~~ the agricultural fibres is required, then drying will be required to prolong ~~its—shelve-life~~ their shelf-life. No chemical is used during the hydrothermal processing of the EFB fibres and hence no polluting discharge is generated. The exhausted steam can be condensed into water and recycled accordingly.

Please replace the 1st paragraph starting on page 6 of the filed application with the following amended paragraph:

The **AgroBinder natural adhesive formulation (e.g., AGROBINDER)** **discloses disclosed** in the present invention is a starch-based adhesive formulation. **AgroBinder The adhesive formulation** can be carrier type, no-carrier type and carrier-no-carrier type depending on the type of starting materials and process applied to the manufacturing of **AgroBinder the adhesive formulation**.

Please replace the 2nd paragraph starting on page 6 of the filed application with the following amended paragraph:

The composition of **AgroBinder the adhesive formulation** comprises of starches as binding agent and retention aid, green-bond developing agents, waterproofing resin and caustic. The binding agent of **AgroBinder the adhesive formulation** is starch that is gelatinized as heated. Other components including caustic, green-bond developing agents and waterproofing resin are auxiliary agents that enhance the properties of starch.

Please replace the 3rd paragraph starting on page 6 of the filed application with the following amended paragraph:

Native and/or modified starch is employed to give the binding power of **AgroBinder the adhesive formulation**. Native starch is an economical source of starch, however, preparation can be lengthy and equipment-intensive. Modified starch can be mechanically and chemically modified. Sensitivity to the source of starch including tapioca starch, corn starch, sorghum starch and potato starch is not observed. The advantage of using modified starch comes from its enhanced properties such as improved solubility, paste stability, viscosity stability, enhanced adhesivity and resistance to freeze-thaw degradation and microbial activity, higher solid content and controlled electron charge density, etc. It eases the manufacturing process and reduces one-time manufacturing investment. A variety of chemically modified starches are suitable for the

preparation of **AgroBinder the adhesive formulation**. This includes typically cross-bonded starch, oxidized starch, cationic starch modified with tertiary amino or quaternary ammonium compounds and starch-derivatives which is the choice of required finishing properties of the starch adhesive.

Please replace the 4th paragraph starting on page 6 of the filed application with the following amended paragraph:

Modified ~~starch~~ **starches** used in the preparation of **AgroBinder the adhesive formulation** are typically those of Rouquette, Cerestar, Kalamazoo, etc. Unmodified starches that are used in the non-carrier phase include potato starch, corn starch and tapioca starch. Dextrins have been proved fit as carrier and it can be prepared or purchased.

Please replace the 5th paragraph starting on page 6 of the filed application with the following amended paragraph:

Retention aid is a crucial component of **AgroBinder the adhesive formulation**. Many types of retention aids are available. The preferred choice of the present invention is modified starch, typically as oxidized starch. It also forms part of **the** carrier phase of the adhesive formulation. Its presence enables the starch adhesion, **AgroBinder the adhesive formulation**, to retain to **AgroFibre the processed agricultural fibres** during the preparation of **AgroFibre an agricultural fibre** slurry.

Please replace the 1st paragraph starting on page 7 of the filed application with the following amended paragraph:

If additional water repellency is required for **AgroBinder the adhesive formulation**, water resistant resins can be added to the starch adhesive formulation. Typically, they are cross-linking agents that react with available hydroxyl groups of starch. A number of compounds including polyvinyl alcohol and polyvinyl acetate, methylcarboxylate cellulose and glyoxal meet the required performance. These cross-linking agents reduce the hydrophilic nature of starch-

based adhesive by screening hydrophilic sites through developed hydrophobic moieties.

Please replace the 3rd paragraph starting on page 7 of the filed application with the following amended paragraph:

If ordinary native starches are used, jet cooker and live steam are recommended for the preparation of **AgroBinder the adhesive formulation** to facilitate starch dissolution. Potassium hydroxide can be used instead of sodium hydroxide. Boric acid and other boron-containing compounds are alternatives to borax used in the preparation of **AgroBinder the adhesive formulation**.

Please replace the 4th paragraph starting on page 7 of the filed application with the following amended paragraph:

Potato starch, tapioca starch and cornstarch are suitable for the above preparation and the resulted **AgroBinder adhesive formulation** shows similar performance in slurry application for making of moulded shape bodies and paper liner.

Please replace the last paragraph starting on page 7 of the filed application with the following amended paragraph:

The preparation of **AgroFibre the agricultural fibre** slurry is described next. **AgroFibre The processed agricultural fibres** [30] ~~is~~ are added to water [50] in a mixing tank [65] and dispersion of **AgroFibre the agricultural fibres** is facilitated via vigorous agitation. Preferred consistency of **AgroFibre the agricultural fibre** slurry is 2-6% of (weight percentage) **AgroFibre agricultural fibres** to water ratio. **AgroFibre swells The agricultural fibres swell** under solvation effect of water and a higher consistency leads to poor solvated **AgroFibre agricultural fibres**. **AgroBinder The adhesive formulation** [10] is then added to the mixture in the mixing tank [65] and continuous agitation is carried out. ~~Due to the self-retention property,~~

Please replace the 1st paragraph on page 8 of the filed application with the following amended paragraph:

Due to the self-retention property, AgroBinder the adhesive formulation is attached to the **AgroFibre processed agricultural fibres**. Mixing is carried out for 10 to 60 ~~min~~ **minutes** to give a well furnished **AgroFibre agricultural fibre** slurry [80]. Functional additives [51] such as sizing and wet strength, if required, are then added to the mixture. Vigorous agitation should be avoided to ensure better retention of functional chemicals to **AgroFibre the agricultural fibres**. The solid content of the **AgroFibre agricultural fibre** slurry preferably comprises 80 to 95 wt % of **AgroFibre agricultural fibres**, 5 to 15 wt % of **AgroBinder adhesive formulation**, and less than 5 ~~wt~~ % of other additives. It is evident that the principal component of the **AgroFibre agricultural fibre** slurry is **AgroFibre agricultural fibres**--the mechanical hydrothermally processed agricultural fibres.

Please replace the 2nd paragraph starting on page 8 of the filed application with the following amended paragraph:

The ~~said AgroFibre agricultural fibre~~ slurry [80] can be diluted by adding even more water to produce low consistency slurry (0.1% to 3%). Slurry consistency of 0.3 to 1.5% is preferred if moulded shaped bodies are to be produced using ~~processes~~ similar to moulded pulp manufacturing. Moulded **AgroFibre agricultural fibre** shaped bodies are formed through vacuum dewater, followed by mechanical dewater and thermal curing at pressures of 0.2 to 2 MPa and temperatures between 120 to 200 deg C. Heating under applied pressure facilitates the curing process and strengthens the mechanical properties of the moulded shaped bodies. The cured adhesive binds all the plant fibres together forming a strong moulded shaped body.

Please replace the 3rd paragraph on page 8 of the filed application with the following amended paragraph:

~~In another~~ **Another** preferred application of the ~~said AgroFibre~~ **agricultural fibre** slurry is in making of paper liners. Low consistency ~~AgroFibre~~ **agricultural fibre** slurry is fed into a paper making machine the way low consistency pulp is used. Low consistency slurry ensures good formation and uniformity in the produced paper liners.